WSDOT WETLAND MITIGATION SITES

SOUTHWEST REGION

MONITORING REPORT

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INTRODUCTION

History

The Washington State Department of Transportation (WSDOT) facilitates responsible implementation of transportation services, in part by providing leadership to foster environmental stewardship. WSDOT strictly adheres to all applicable federal, state and local environmental regulations, including the Clean Water Act and the state "no net loss" policy for wetlands (Executive Order 1989).

Infrastructure improvements have accompanied economic and population growth in the state of Washington. WSDOT routinely evaluates the potential for degradation of critical areas resulting from infrastructure improvements. Generally, mitigation sites are planned when transportation improvement projects affect critical areas. Monitoring provides a means to track the status and development of these mitigation sites. These sites are monitored by the WSDOT Wetland Monitoring Program. Beginning with six sites in 1988, the number of sites monitored annually has grown steadily. Fifty-one sites were monitored in 2000 (Figures 1 and 2).

Purpose

The purpose for this document is to report the status of WSDOT mitigation sites as observed in 2000. Permit compliance and the development of wetland characteristics are addressed as appropriate. We rely on feedback from the users of this report to ensure its contents are clear, concise and meaningful.

Process

Site monitoring typically begins in the first spring after the site is planted. Sites are monitored for the time period designated by the permit or mitigation plan. The monitoring period generally ranges from three to ten years. Monitoring activities may vary depending on site and permit requirements, stage of site development, and other factors.

Data are collected on a variety of site parameters including vegetation, hydrology, and wildlife. Monitoring activities are driven by site-specific success standards detailed in the mitigation plan. Analysis of monitoring data provides information for an evaluation of site development and permit compliance.

Monitoring data has several intended uses, including the following. The monitoring program staff use results from data analysis to communicate issues related to site development and to report compliance to permit success standards to regional staff and permitting agencies. Regional staff uses data provided by the monitoring team to plan appropriate maintenance and remediation activities. Permitting agencies use the data to track and document compliance.

Methods

Methods used for mitigation site monitoring have changed as site requirements and customer needs have evolved. Our historical data collection methods are described in the ***Guide for Wetland Mitigation Project Monitoring*** (Horner and Raedeke 1989). These methods were initially adopted as a standardized set of protocols, with vegetation, hydrology, soil, wildlife and benthic macroinvertebrate data collected on every site, every year.

As the number of sites being actively monitored increased, these standardized protocols have been modified. During this period, program staff began to evaluate monitoring methods used by other groups and agencies. This effort led to a major change in the methods used to monitor WSDOT mitigation sites. The data collection techniques currently in use include standard ecological and biostatistical methods.[1]

There are several important differences between our historical and current monitoring methods. Brief descriptions of these changes follow.

Objective-based monitoring: Instead of routinely collecting data for a wide range of environmental parameters, we presently collect data using a monitoring plan and sampling design developed specifically for that site. The monitoring plan and sampling design address individual requirements such as success standards, site development, invasive species, and other considerations as required.

Adaptive management: Monitoring is a critical component of the adaptive management process, driven by site-specific management objectives that describe a desired condition (Elzinga et al. 1998). Through appropriate sampling design and collection of valid data, monitoring determines if the objectives have been achieved. Monitoring provides the link between objectives and management activities. Without valid data to accurately identify deficiencies, appropriate corrective management activities cannot be conducted. Alternately, with poor data, unnecessary management may occur.

Statistical rigor: In the analysis of biological data it is common to discover that too few data were collected for reliable conclusions to be drawn (Krebs 1999; Zar 1999). In addition, data must be collected using some type of random sampling procedure (Elzinga 1999). The monitoring program presently uses a variety of tools to remove subjectivity from data collection and to increase the reliability of our results. Our goal is to provide customers with an objective evaluation of site conditions based on valid monitoring data.

[1] New methods combine changes in sampling design with rigorous statistical analysis to more accurately portray vegetative development on mitigation sites. New methods are based on techniques described in Bonham (1989), Elzinga (1998), Krebs (1999), Zar (1999), and other sources.

Success standards: An important element in any mitigation plan is the objectives and success standards (Ossinger 1999). They serve to indicate the desired state or condition of the mitigation site at a given point in time. Some also provide contingencies if a specific condition is met, such as low aerial cover of woody species or exceeding a threshold of invasive species.

Monitoring program staff use the success standards and contingencies as the basis for establishing management objectives for each site. Management objectives are derived directly from the success standards contained in the mitigation plan and/or site permit. In this process, the goals, objectives, and standards for success and site permit are carefully examined to understand the intended site attributes or characteristics. Each management objective contains six required elements; species indicator, location, attribute, action, quantity/status, and time frame (Elzinga 1999). These elements help describe the desired site condition.

Many management objectives require a companion sampling objective. When the management objective identifies a threshold, such as aerial cover or survival rate, the sampling objective includes a confidence level and confidence interval half width.[2] These are noted as ($CI = X \pm Y$), where CI = confidence interval, X = confidence level, and Y = confidence interval half width. For example, should you see an estimated aerial cover of herbaceous species shown as 65% ($CI = 0.80 \pm 0.20$) in a report, this means that we are eighty percent confident that the reported value is within twenty percent of the true value. In this case, our estimated value is sixty-five percent, and we are eighty percent confident the true aerial cover value is between seventy-eight percent and fifty-two percent.

Two examples of how these will appear in the report follow:

From the Mitigation Plan or Permit:

Success Standard
Upland and riparian forested buffer areas should have 50% cover by forested species planted, or be supplemented or replaced by a native naturally colonizing upland forested plant community at 50% or greater cover.

Derived from the Mitigation Plan or Permit:

Management Objective
Achieve 50% aerial cover of forested and scrub-shrub species in the riparian buffer on the SR 18 Issaquah-Hobart mitigation site by 2001.

[2] The confidence level indicates the probability that the confidence interval includes the true value. The confidence interval half width will decrease as the confidence level decreases (Elzinga 1998).

Companion to the Management Objective:

Sampling Objective 2

To be 80% confident the mean aerial cover estimate for forested and shrub species in the riparian buffer is within 20% of the true cover value.

From the Mitigation Plan or Permit:

Contingency Plan

The mitigation plan is designed to use and promote the growth of native vegetation. Attempts will be made to limit the spread of exotic species, which will not be allowed to dominate the site. Noxious weeds will be eliminated immediately if found occurring on the site, before large populations can establish. A weed control program will be implemented if more than 5% of the coverage in the wetland is deleterious exotic species.

Derived from the Contingency Plan:

Management Objective

To maintain the combined level of deleterious exotic species at $\leq 5\%$ aerial cover at the Profitt's Point mitigation site in each year of the monitoring period (2000-2005).

Companion to the Management Objective:

Sampling Objective 3

To be 80% confident that the aerial cover estimate for the combined level of deleterious exotic species is within $\pm$ 20% of the true value.

Mitigation plans and permits frequently contain success standards that are not measurable. One example of this is attempting to measure the survival of woody species in the third year of monitoring. Wetlands are highly productive systems that produce substantial biomass. In most cases, planted woody species that have died cannot be reliably located after three years, and usually will have decayed beyond recognition as a planted species. **Success standards that are not measurable or do not apply to the current year's activities do not have management or sampling objectives in this report.**

The management objectives, sampling objectives, and the success standard from which they were derived are in the text of each site report. The complete objectives and success standards from the mitigation plan for that site are in the appendices of each report.

Intensity of Monitoring

Monitoring is conducted primarily for two purposes (Elzinga et al. 1998). One is to detect biologically significant changes in abundance, condition, or population structure. Estimates of aerial cover and survival of plantings are examples of attributes that can be

measured to detect biologically significant change. The other purpose is to understand the effects of management activities on ecosystems or plant communities.

Parameters for monitoring activities are grouped into two levels, qualitative or quantitative, based on the level of effort or intensity of data collection. Qualitative techniques are generally less intensive than quantitative techniques (Elzinga et al. 1998). Qualitative monitoring provides general information such as presence or absence of specific plant species, hydrology indicators, or assessment of site conditions. Also, photographs are generally taken to document current site conditions. A library of site photographs is available in the program office.

Quantitative monitoring provides information on aerial cover, condition, or site characteristics. Random sampling methods are required to produce a statistically credible estimate of a characteristic when only a portion of a site is sampled (Zar 1999). When practical, a total census gives an accurate count of the population rather than an estimate. A variety of methods and tools are used to collect quantitative data, including the line intercept method (Canfield 1941; Bonham 1989), the point intercept method (Bonham 1989; Elzinga et al. 1998), point-intercept devices, point frames, and others. A detailed description of the specific data collection methods used is included in each site report.

The requirements within the permits and mitigation plan can adequately be addressed qualitatively in some years, and in others, quantitative monitoring is appropriate. If there are success standards for this year of the monitoring period, a report follows in this document. In other cases, qualitative monitoring was conducted, and the results communicated internally to the appropriate environmental manager. This feedback allows the site manager to conduct any corrective activities prior to the time that the next success standard will be quantitatively monitored.

Literature Cited

Bonham, C.D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons, New York, NY.

Canfield, R. H. 1941. Application of the Line Interception Method in Sampling Range Vegetation. J. For. 39:388-394.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+1730.

Executive Order 89-10. Protection of Wetlands. December 11, 1989.

Horner, R. R. and K. J. Raedeke. 1989. Guide for Wetland Mitigation Project Monitoring - Operational Draft. Prepared for Washington State Transportation Commission, Department of Transportation, Olympia, Washington. WA-RD 195.1.

Krebs, C. J. 1999. Ecological Methodology, 2nd edition. Benjamin/Cummings, New York, NY.

Ossinger, M. 1999. Success Standards for Wetland Mitigation Projects – a Guideline. Washington State Department of Transportation, Environmental Affairs Office.

Zar, J.H. 1999. Biostatistical Analysis, 4th edition. Prentice-Hall, Inc., Upper Saddle River, NJ.

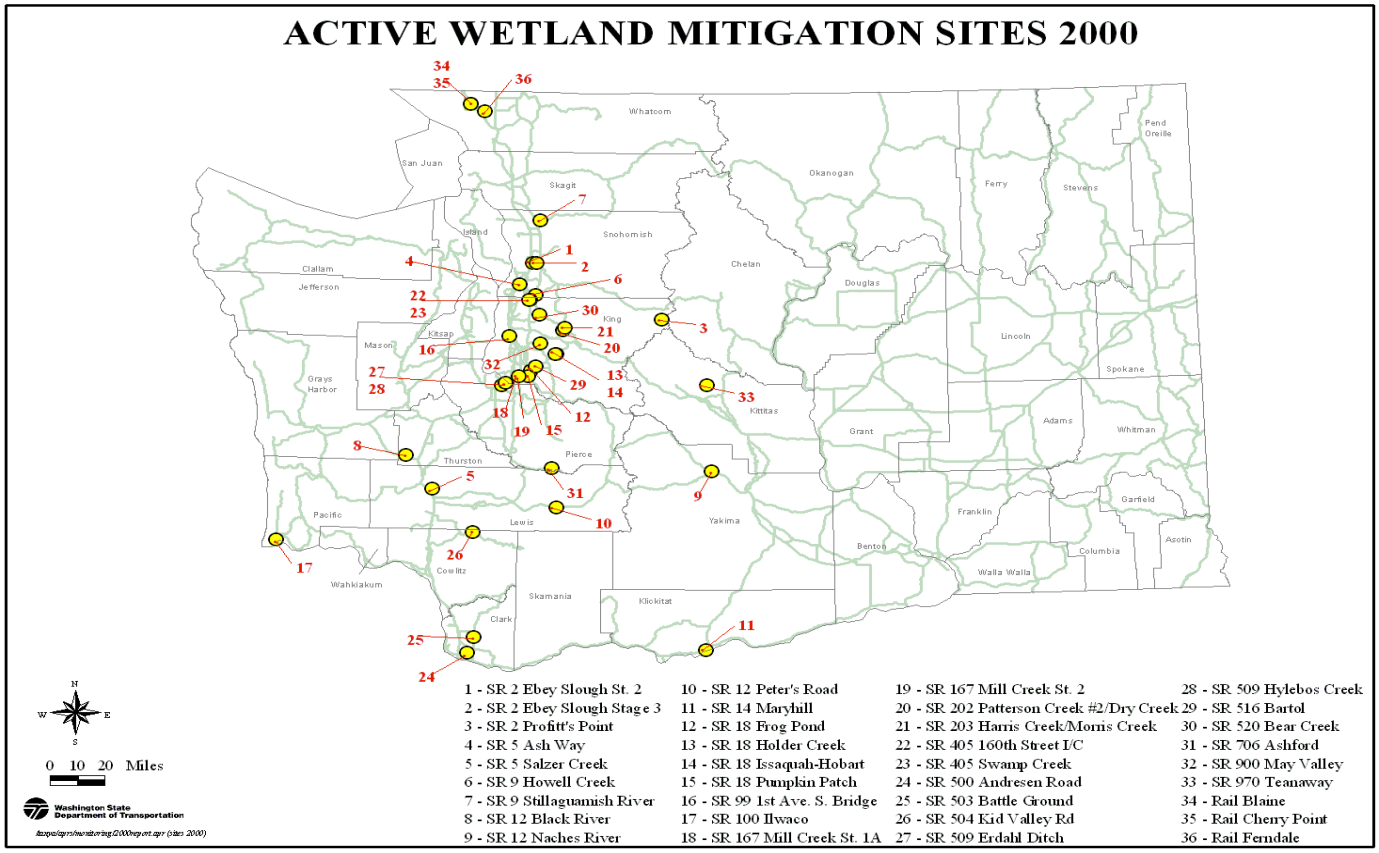

Figure 1: WSDOT Mitigation Sites Monitored in 2000

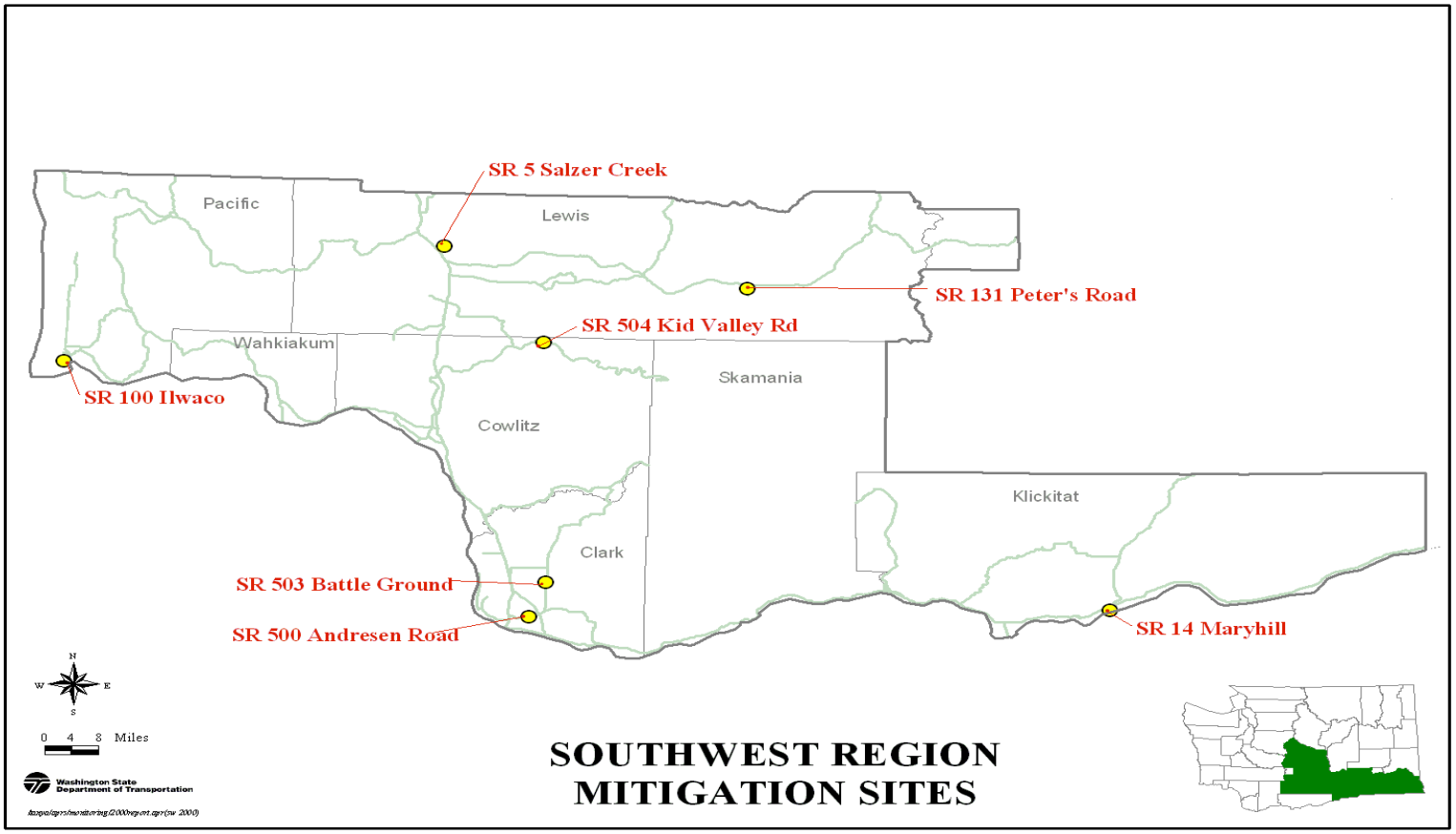

FIGURE 2: Southwest Region Mitigation Sites Monitored in 2000

SR 12 Peters Road, Lewis County

The following report summarizes monitoring activities completed by the Washington State Department of Transportation (WSDOT) Wetland Monitoring Program at the SR 12 Peters Road wetland mitigation site in September 2000. Activities include surveys of woody and herbaceous vegetation.

Site Information

Site Name	SR 12 Peters Road
Project Name	SR 12 Peters Road Slide Repair
Location	Lewis County, Washington
Township/Range/Section	T12N R7E S7
Monitoring Period	1999-2008
Year of Monitoring	2 of 10
Area of Project Impact	1.1 ha (2.6 ac)
Type of Mitigation	Restoration of non-wetland riparian forest
Area of Mitigation	2.1 ha (5.3 ac)
Replacement Ratio	2:1

Management and Sampling Objectives

Monitoring objectives for the SR 12 Peters Road Slide Repair project were developed from second year standards of success described in the *Wetland Mitigation Plan State Route 12 Peters Road Slide Repair* (WSDOT 1998). The complete text of the success standards is presented in Appendix A. Success standards, management objectives, and sampling objectives addressed this year are listed below.

Success Standard

In any monitoring year except year ten, the combined aerial cover of noxious or invasive non-native species throughout the site will not exceed 15%. In year ten, this combined aerial cover will not exceed 10%.

Management Objective 1

To maintain the combined level of noxious or invasive non-native species at an aerial cover of 15% or less at the Peter's Road mitigation site for the first 9 years of the 10-year monitoring period (1999-2008). [3]

Sampling Objective 1

To be 80% confident that the aerial cover estimate for the combined level of noxious or invasive non-native species is within 20% of the true value.

[3] In year ten the combined aerial cover of noxious or invasive non-native species is not to exceed 10%.

Success Standard
In the second year following construction, the site (all communities) will have at least 10% aerial vegetative cover from woody plants alone.

Management Objective 2
To achieve 10% or greater aerial cover of woody species on the Peter's Road mitigation site in the 2nd year of monitoring (2000).

Sampling Objective 2
To be 80% confident that the aerial cover estimate for woody species is within 20% of the true value.

Methods
A 171-m baseline was strategically placed using a systematic random sampling method along the northern site boundary. Fifty-seven transects were extended across the site perpendicular to the baseline to sample both woody and herbaceous vegetation.

The point intercept technique (Bonham 1989; Elzinga et al. 1998) was used to collect aerial cover data for noxious or invasive non-native species. Following a random start, point quadrats were systematically placed along sampling transects. At each point location, a pin was lowered vertically from above the tallest herbaceous vegetation on the west-side of the transect tape. Each plant species intercepted by the pin was recorded. If the pin did not intercept vascular plant species, data was recorded as bare soil, non-vascular plant, or habitat structure. Because of the clumped distribution of the species of concern, 2988 data points were collected to achieve the statistical confidence specified in management objective one.

Cover for the woody species plant community was collected using the line-intercept method (Canfield 1941; Bonham 1989). All woody vegetation intercepting a tape-measure stretched along each sampling transect was identified, and the length of the canopy intercept was recorded. To achieve the statistical confidence interval specified in sampling objective two, 57 sample units were obtained, one from each transect length.

The following sample size equation was used to evaluate the number of sample units required to attain the sampling objectives.

$$n = \frac{(z)^2(s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[4]
n = unadjusted sample size

Results and Discussion

The combined aerial cover value of noxious or invasive non-native species is estimated at 9% (CI 0.90 ± 0.10), below the threshold of 15% specified in the management objective. *Cirsium arvense* (Canadian thistle) at 7% (CI 0.80 ± 0.20) contributes most of this cover while *Cirsium vulgare* (bull thistle), *Rubus armeniacus* (Himalayan blackberry), and *Rubus laciniatus* (evergreen blackberry) are also present at low cover levels.[5]

Analysis indicates planted woody species provide an aerial cover of 2% (CI 0.90 ± 0.20) aerial cover. This is below the 10% level prescribed in management objective one.[6] Regional mangers have scheduled replanting for the fall of 2001.

Appendix A includes a list of woody plant species recorded during monitoring visits to the SR 12 Peters Road mitigation site in 2000.

[2]The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.
[5]The scientific name for Himalayan blackberry has been changed from *Rubus procerus* to *Rubus armeniacus.*
[6] Existing *Acer macrophyllum* (big-leaf maple) trees on site were not included in the aerial cover of woody species estimate.

Table 1. **Aerial cover estimates for woody species on site show the management objective has not been achieved for woody spp. cover. The management objective for invasive species has been achieved.**

Total Site	Woody Species (Objective 1)	Invasive Species (Objective 2)
Total Aerial Cover	2 %	9%
Management Objective	Not Achieved	Achieved

Literature Cited

Bonham, C. D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons, New York, NY.

Canfield, R. H. 1941. Application of the Line Intercept Method in Sampling Range Vegetation. J. For. 39:388-394.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+1730.

Washington State Noxious Weed Control Board. 1999. State Noxious Weed List and Schedule of Monetary Penalties. Washington Administrative Code, Chapter 16-750. In: Chapter 17.10 RCW. 99-24-029, filed 1999.

Washington State Department of Transportation. 1998. Peters Road Vicinity Slide Repair Wetland Mitigation Plan. Project number OL-2703.

Appendix A

The following excerpt is from the *Peter's Road Vicinity Slide Repair Wetland Mitigation Plan* (Washington State Department of Transportation 1998). The standards addressed this year are identified in **bold** font. Other standards will be addressed in the indicated monitoring year.

Goals, Objectives and Standards of Success

Goals: The general goal of this wetland mitigation plan is two fold:

- Restore a non-wetland flood plain forest similar to what existed historically, and is currently present in the northwest portion of the property. This forest will eventually more than offset the functions lost at the impacted wetland.
- Reduce stream bank slumping by stabilizing with bioengineering techniques.

Objective #1: Riparian Forest - Restore at least 2.1 ha (5.3 ac) of pasture to a riparian forest on the Cowlitz River floodplain.

Standard of Success: Noxious Species

- **In any monitoring year except year ten, the combined aerial cover of noxious or invasive non-native species throughout the site will not exceed 15%. In year ten, this combined aerial cover will not exceed 10%. These plants include the following:**

  Cirsium vulgare (bull thistle)
  Cirsium arvense (creeping thistle)
  Xanthium strumarium (rough cocklebur)
  Rubus procerus (Himalayan blackberry)

Standards of Success: Tree and Shrub Plantings

- The first year following construction will have a minimum of 80% survival of the planted trees and shrubs with no less than 25% survivorship of each individual species.
- **In the second year following construction, the site (all communities) will have at least 10% aerial vegetative cover from woody plants alone.**
- In the fifth year following construction, the site (all communities) will have at least 40% aerial vegetative cover from woody plants alone.
- In the tenth year following construction, the site (all communities) will have at least 75% aerial vegetative cover from woody plants alone.

Objective 2: Stream bank Stabilization - Stabilize approximately 30 linear meters (100 linear feet) of river bank within WSDOT property of the mitigation site.

Standards of Success: Because this section of the river bank is on a bend where erosive conditions are dynamic and at times climactic, these standards may be difficult to achieve. Those that follow are predicated on the prepared area not being destroyed by a major flood event.

- In the first year following construction, at least 50% of all as-built planted material (live stakes and/or seedlings) in the bank stabilization area will have sprouted.
- In the second year following construction, the bank stabilization area will have at least 10% aerial vegetative cover from woody plants alone.
- In the fifth year following construction, the bank stabilization area will have at least 40% aerial vegetative cover from woody plants alone. Signs of erosion will be few to minimal or none.
- In the tenth year following construction, the bank stabilization area will have at least 75% aerial vegetative cover from woody plants alone. Signs of erosion will be minimal to none.

SR 12 Peters Road Plant List
Tree and Shrub Species

Species Name	Common Name	Status	Origin
Acer circinatum	vine maple	FAC-	Native
Berberis aquifolium	tall Oregon grape	NL	Native
Cornus sericea	red-osier dogwood	FACW	Native
Fraxinus latifolia	Oregon ash	FACW	Native
Physocarpus capitatus	Pacific ninebark	FACW-	Native
Prunus sp.	plum, cherry	---	
Pseudotsuga menziesii	Douglas fir	FACU	Native
Rhamnus purshiana	cascara	FAC-	Native
Rubus laciniatus	evergreen blackberry	FACU+	Eur
Rubus armeniacus	Himalayan blackberry	FACU	Eur
Rubus parviflorus	western thimbleberry	FAC-	Native
Rubus spectabilis	salmonberry	FAC+	Native
Salix sp.	willows	---	
Salix scouleriana	Scouler willow	FAC	Native
Salix sitchensis	Sitka willow	FACW	Native
Spiraea douglasii	Douglas' spiraea	FACW	Native
Symphoricarpos albus	common snowberry	FACU	Native

SR 14 Maryhill, Klickitat County

The following report summarizes monitoring activities completed at the SR 14 Maryhill State Park mitigation site in August 2000 by the Washington State Department of Transportation (WSDOT) Wetland Monitoring Program. Activities include a qualitative vegetation survey.

Site Information

Site Name	Maryhill
Project Names	SR 14 Maryhill State Park
Location	Maryhill State Park, Klickitat Co., WA
Monitoring Period	1999 to 2001
Year of monitoring	2 of 3
Type of mitigation	Enhancement, Enlargement
Area of mitigation	1.4 ha (3.5 ac), 0.3 ha (0.8 ac)

Monitoring and Sampling Objectives

The *Maryhill State Park Wetland Enhancement Agreement* (Smith and Pinnix 1996) requires three years of monitoring, but set no goals, objectives or standards of success. The above agreement also directs WSDOT to develop and implement remedial activities if the Wetland Enhancement Area fails to develop successfully. Appendix B contains excerpts from Smith and Pinnix (1996) regarding monitoring at this site.

Results and Discussion

WSDOT Monitoring staff visited the site on August 14, 2000. As noted in the prior Monitoring Report (Dreisbach 1999), the woody species plantings on the slope around the wetland and in the upland areas are mostly dead. Herbaceous species in the upland provide minimal cover, leaving bare ground exposed in this zone. *Rubus armeniacus* (Himalayan blackberry) is colonizing the banks of the Columbia River and in the preserve area. Weed control activities include hand pulling *Centaurea solstitialis* (yellow star thistle) in late July 1999, and again in the fall of 2000. Additional weed control activities are planned for the summer of 2001.

In the Wetland Enhancement Area, the woody species that survived initial planting, mostly *Populus* and *Salix* species, are doing well. Regional staff are re-grading the wetland area to decrease the extent and depth of the two ponds. Those areas will be re-planted with *Salix* species during the winter of 2000/2001. Appendix B contains a list of plant species observed at this site in 2000.

Site hydrology appears sufficient to support the continued development of wetland plant communities. Mammal scat and several fish species have been observed on site, indicating wildlife use despite the proximity of construction and recreation activities.

Literature Cited

Smith, G. E., and C. Pinnix. 1996. Maryhill State Park Wetland Enhancement Agreement. GCA-0381. 9 pages.

Dreisbach, P. 1999. WSDOT Wetland Mitigation Sites Southwest Region 1999 Monitoring Report. Washington State Department of Transportation Environmental Affairs Office.

Reed, P. B. Jr. 1993. Supplement to List of Plant Species that Occur in Wetlands: Northwest Region (Region 9). U. S. Fish and Wildlife Service Supplement to Biological Report 88 (26.9).

Appendix B

Goals, Objectives and Standards of Success

The plan makes two provisions for wetland establishment and monitoring (Smith and Pinnix, 1996).

1. If, in the opinion of WSDOT biologists, the Wetland Enhancement Area is not developing successfully, WSDOT shall develop and implement a remedial action plan.
2. At the completion of the three (3) year monitoring period WSDOT and State Parks will arrange for a joint site inspection. If it is determined that remedial action (such as replanting) is needed, WSDOT will remain responsible for the site until such remediation has been completed.

SR 14 Maryhill Plant List 2000

Species Name	Common Name	Status	Origin
Bromus tectorum	cheat grass	NL	Eur
Hordeum brachyantherum	meadow barley	FACW-	Native
Vicia cracca	tufted vetch	NL	Intro
Lactuca serriola	prickly lettuce	FACU	Eur
Medicago sativa	alfalfa	NI	Eur
Centaurea solstitalis	yellow star-thistle	NL	Intro
Eleocharis palustris	common spikerush	OBL	Native
Lindernia dubia	yellowseed false pimpernel	OBL	Native
Centaurea diffusa	white knapweed	NL	Intro
Salix sessilifolia	northwest sandbar willow	FACW	Native
Agrostis capillaris	colonial bentgrass	FAC	Eurasia
Leersia oryzoides	rice cutgrass	OBL	Native
Populus sp.	cottonwoods	---	---
Rubus armeniacus	Himalayan blackberry	FACU	Eur
Achillea millefolium	common yarrow	FACU	Native
Salsola iberica	prickly Russian thistle	FACU	Intro
Typha latifolia	broad-leaf cattail	OBL	Native
Salix lucida	Pacific willow	FACW+	Native

SR 503 Battle Ground Sites, Clark County

The following report summarizes monitoring activities completed at the three SR 503 Battle Ground mitigation areas during the spring and summer 2000 by the Washington State Department of Transportation (WSDOT) Wetland Monitoring Program. Activities include vegetation surveys, bird surveys, and a qualitative assessment of overall site development. This report documents the fifth and last planned year of monitoring.

Site Information

Site Name	SR 503 Battle Ground
Project Name	SR 503 NE 144th Street to Battle Ground
Permit Number	92-4-00509
Permitting Agency	USACOE
Location	Near Battle Ground, Clark County
Monitoring Period	1996 to 2000
Year of monitoring	5 of 5
Area of project impact	3.99 ha (9.89 ac)
Type of mitigation	Emergent (EM), Scrub-Shrub (S/S), Forested (FO), Open Water (OW), and Preservation
Area of mitigation	EM = 1.29 ha (3.19 ac), S/S = 0.96 ha (2.37 ac), FO = 1.28 ha (3.17ac), OW = 0.26 ha (0.65 ac), and preserved = 0.88 ha (2.18)
Replacement Ratios	EM = 1.5:1, S/S = 46:1, FO = 2:1

Management and Sampling Objectives

Monitoring objectives for the Battle Ground sites were developed from the Standards of Success included in *NE 144th Street to Battle Ground SR 503 Wetland Mitigation Plan* (Clay-Poole S.T. 1992). The complete text of the success standards is presented in Appendix A. Success standards, management objectives, and sampling objectives addressed this year are listed below. Management objectives without corresponding sampling objectives are addressed in the methods section.

Success Stanard

By the end of the fifth year of monitoring, success will be obtained if there is 80% areal coverage of native herbaceous species in the emergent zone in those areas indicated on the plan sheets, 80% areal coverage of native shrubs in the scrub-shrub zone, and 80% viability of all trees planted in the forested zone.

Management Objective 1

Achieve 80% aerial cover of native woody species in the scrub-shrub and forested wetland zones of the SR 503 Battle Ground mitigation sites in 2000.

Sampling Objective 1
To be 80% confident that mean aerial cover estimates for native woody species within the scrub-shrub and forested wetland zones are within 20% of the true cover value.

Success Standard
By the end of the fifth year of monitoring, success will be obtained if there is 80% areal coverage of native herbaceous species in the emergent zone in those areas indicated on the plan sheets, 80% areal coverage of native shrubs in the scrub-shrub zone, and 80% viability of all trees planted in the forested zone.

Management Objective 2
Achieve 80% aerial cover of native herbaceous species in the emergent wetland zones of the SR 503 Battle Ground mitigation sites in 2000.

Sampling Objective 2
To be 80% confident that mean aerial cover estimates for native, herbaceous species in the emergent wetland zones are within 20% of the true cover values.

Success Standard
Wildlife cover and forage species should be established equal to percentages listed for vegetative structural and species diversity. A visual increase in species should be observed.

Management Objective 3
Observe an increase in wildlife species at the SR 503 Battle Ground wetland mitigation sites between 1996 and 2004.

Methods
In order to evaluate site vegetation, temporary macroplots or quadrats were established on each of the three SR 503 Battle Ground mitigation areas, as appropriate for site conditions. Transects were established using either systematic random or restricted random sampling methods. Transects were extended perpendicular to the baseline.

The line-intercept method (Canfield 1941; Bonham 1989) was used to obtain data for planted woody species to address management objective one. The length of canopy cover intercepting the transect tape was recorded for each species.

To collect aerial cover data for herbaceous species point quadrats were randomly located by various methods. At each quadrat, the point intercept technique (Bonham 1989; Elzinga et al. 1998) was used to obtain data. A pin flag was lowered vertically from above the tallest vegetation on the west side of the transect tape. Each plant species intercepted by the pin flag was recorded. If the pin flag did not intercept vascular plant species, data was recorded as bare soil, non-vascular plant, or habitat structure.

Sample size analysis was conducted to evaluate if the above sampling objectives had been achieved. The following equation was used to perform this analysis.

$$n = \frac{(z)^2(s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[7]
n = unadjusted sample size

Four bird surveys were conducted at each of the three mitigation areas from May through July. The point count method (Ralph et al. 1993) was used to document species presence and relative abundance.

Implementation of the monitoring methods for vegetation varied somewhat between the three mitigation areas; they are addressed separately below as Battle Ground East, Battle Ground Center, and Battle Ground West. Appendix C includes a list of plant species recorded for each of the three mitigation areas during our 2000 visits.

[7] The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

Sample Design and Results

Battle Ground East:

To determine the aerial cover of planted woody species the scrub-shrub and forested zone was divided into a grid of 57 quadrats. A sample of 20 quadrats were randomly selected from the grid for evaluation. Two temporary macroplots covering the area around the ponds were used to evaluate cover of native herbaceous species in the respective emergent areas.

Analysis of line-intercept data indicates that the aerial cover estimate of native woody species in the scrub-shrub and forested zone is 18% (CI 0.80 ± 0.36), well below the required 80% cover for the fifth year by Objective 1.

Point intercept data indicates that the aerial cover estimate of native herbaceous species in the emergent zone surrounding the north and south ponds is 67% (CI 0.90 ± 0.10) and 53% (CI 0.90 ± 0.15) respectively. Although communities of native species are present in the emergent areas, the estimates of cover they provide are lower than requirements of the fifth year standard. However, the site is developing a wetland plant community with high cover values. The estimate of aerial cover provided by FAC and wetter species is 78% (CI 0.95 ± 0.10) around the north pond (macroplot one), and 97% (CI 0.99 ± 0.05) around the south pond (macroplot two). This shows that the emergent areas have developed relatively dense cover by wetland species.

Based on qualitative estimates, the cover provided by invasive species on this site was about 30%. The following Class C Noxious weeds (Washington State Noxious Weed Control Board 2000) were present: *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), *Cytisus scoparius* (Scotch broom), *Hypericum perforatum* (common St. John's-wort), *Lythrum salicaria* (purple loosestrife), and *Phalaris arundinacea* (reed canarygrass). Other species of concern include: *Crepis* species (hawksbeard), *Daucus carota* (Queen Anne's lace), *Hypochaeris radicata* (spotted cat's-ear), *Rubus armeniacus* (Himalayan blackberry), and *Leucanthemum vulgare* (oxeye-daisy).

Table 1. Cover requirements for woody species in the scrub-shrub and forested zone and native emergent species in the emergent zone have not been achieved.

Management Objective 1 80% Aerial Cover Required	**Native Woody Species**
Estimated Aerial Cover	18%
Management Objective	Not Achieved

Management Objective 2 80% Aerial Cover Required	**North Pond**	**South Pond**
Emergent Native Species	67%	53%
Management Objective	Not achieved	Not achieved
FAC and Wetter Species	78%	97%

Battle Ground Center:
To evaluate the aerial cover of planted woody species, a temporary macroplot was established in the scrub-shrub and forested zone. To achieve the statistical confidence interval specified in sampling objective one, data were collected from 65 sample units of 12m in length.

To evaluate vegetation in the emergent area, a second temporary macroplot was established in the area around the pond. To achieve the statistical confidence interval specified in sampling objective two, data were obtained at 399 points in the emergent zone.

Analysis of line-intercept data indicates that the estimate of aerial cover of native woody species in the scrub-shrub and forested zone is 21% (CI 0.8 ± 0.18), well below the required 80% cover for the fifth year Objective #1. Human use includes off-road vehicles, bicycles, pets, and foot traffic. These activities, especially off-road vehicle traffic, are limiting the development of the woody species community.

Point intercept data indicates that the estimate of aerial cover for native herbaceous species in the emergent zone is 53% (CI 0.99 ± 0.14). Although communities of native species are present in the emergent areas, the fifth year standard of 80% cover has not been achieved. The emergent area around the pond has steep slopes, and based on field indicators, water levels appear to vary nearly a meter per year due to overbank flooding from the adjacent stream. This combination of steep slopes and hydraulic regime does not provide ideal conditions for establishment of emergent vegetation.

Based on qualitative estimates, the cover provided by invasive species on this site was about 25%. Species of concern include: *Daucus carota* (Queen Anne's lace), *Hypochaeris radicata* (spotted cat's-ear), and *Rubus armeniacus* (Himalayan blackberry). In addition, the following Class C Noxious weeds (Washington State Noxious Weed Control Board 2000) were present: *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), and *Phalaris arundinacea* (reed canarygrass).

Table 1. Cover requirements for woody species in the scrub-shrub and forested zone and native emergent species in the emergent zone have not been achieved.

SR 503 Battle Ground Center	Woody Species (Management Objective 1)	Emergent Native Species (Management Objective 2)
Estimated Aerial Cover	21%	53%
Management Objective	Not achieved	Not achieved
Dominant Species	*Rubus armeniacus*	*Agrostis capillaris*
	Rubus spectabilis	*Lotus corniculatus*
	Cornus sericea	*Juncus effusus*
	Symphoricarpos albus	*Phalaris arundinacea*

Battle Ground West:
To determine the aerial cover of planted woody species in the scrub-shrub zone, a temporary macroplot was established on the site. To achieve the statistical confidence interval specified in sampling objective one, a sample unit was randomly positioned along each of 24 transects established in the scrub-shrub zone.

To evaluate herbaceous cover in the emergent zone, point intercept data were collected on each transect. To achieve the statistical confidence interval specified in sampling objective two, 540 points were obtained.

The estimated aerial cover of native woody species in the scrub-shrub and forested wetland areas is 26% (CI 0.80 ± 0.20), well below the required 80% cover in the fifth year Objective 1. The estimated aerial cover of native herbaceous species in the emergent zone is 87% (CI 0.99 ± 0.05), exceeding the fifth year standard of 80%.

Qualitative estimates report undesirable species cover to be about 35%. Species of concern include *Rubus armeniacus* (Himalayan blackberry), *Rubus laciniatus* (evergreen blackberry), and *Leucanthemum vulgare* (oxeye-daisy). The Class C Noxious weeds (Washington State Noxious Weed Control Board 2000) *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), and *Phalaris arundinacea* (reed canarygrass) are also present on site.

Table 1. Emergent native species coverage exceeds the fifth year standard. Requirements for woody species in the scrub-shrub zone have not been achieved.

SR 503 Battle Ground West	Woody Species (Management Objective 1)	Emergent Native Species (Management Objective 2)
Estimated Aerial Cover	20%	87%
Management Objective	Not achieved	Achieved
Dominant Species	*Spirea douglasii*	*Carex obnupta*
		Scirpus microcarpus
		Phalaris arundinacea

Wildlife

The Salmon and Woodin Creek riparian corridors are adjacent to the mitigation areas. These corridors allow wildlife to travel between the three areas, so the data has been combined for all three sites. During the 5 year monitoring period, evidence of wildlife has been documented for the following species: black-tailed deer (*Odocoileus hemionus*), muskrat (*Ondatra zibethica*), coyote (*Canis latrans*), raccoons (*Procyon lotor*), Eastern cottontail (*Silvilagus floridanus*), mature and young bullfrogs (*Rana catesbiana*), Western toads (*Bufo boreas*), Northwestern salamander (*Ambystoma gracile*), and garter snakes (live and partially consumed). Evidence of other wildlife use includes unidentified bird nests, amphibians, amphibian egg masses, swimming and burrowing mammals, fish, and tadpoles.

In 1996, 36 species of birds were observed on these sites. Between 1996 and 1999, 8 additional species of birds were documented on these sites (Dreisbach 2000). Ten of these are considered wetland-dependent including Belted Kingfisher, Canada Goose, Common Yellowthroat, Great Blue Heron, Mallard, Pied-billed Grebe, Red-winged Blackbird, Spotted Sandpiper, Virginia Rail, and Wood Duck (Thomas 1979, Erhlich et al. 1988, Smith et al. 1997). In 1999, Common Yellowthroats were observed actively feeding hatchlings on site.

During formal bird surveys conducted in 2000, 45 species of birds from 21 avian families were recorded. Of these, Marsh Wren, Mallard, Great Blue Heron, Belted Kingfisher, Common Yellowthroat, Spotted Sandpiper, Red-winged Blackbird and Wood Duck are considered to be wetland dependent. The other twenty-two species of birds are known to utilize wetlands for feeding, breeding, or nesting (Thomas 1979; Erhlich et al. 1988; Smith et al. 1997).

A variety of avian use was documented in 2000. A Red-winged Blackbirds nest was identified with eggs in it and Red-winged Blackbirds were feeding young and exhibiting nest defense behavior. A flock of Cedar Waxwings were feeding in the riparian area. Mallards and Wood Ducks with several ducklings were observed in the ponds, and immature Barn Swallows were feeding over the ponds. A Western Wood Peewee was using a raptor perch, Marsh Wrens were using a habitat structure, and areas of *Spiraea douglasii* and *Phalaris arundinacea* were being used as nesting areas.

The number of bird species observed on these sites has increased since 1996. These mitigation sites are providing habitat for many, and possibly an increasing number of wildlife species. The ponds provide water/support for aquatic-dependent birds, mammals and amphibians. As vegetative structure and forage continues to increase on these sites, a corresponding increase in wildlife use of the site is anticipated.

Management Activities

Due to the low aerial cover of woody species on all sites, supplemental plantings are planned for 2001. Appropriate weed control activities are being scheduled for the same time period.

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Appendix C

The following excerpt is from the *NE 144th Street to Battle Ground SR 503 Wetland Mitigation Plan* (Clay-Poole 1992). This mitigation plan applies to the Battle Ground West, Center and East mitigation sites. The standards addressed this year are identified in **bold** font.

Goals: The primary goal of the mitigation plans is to successfully replace the wetlands impacted as well as their particular functions and values. Two sites have been chosen to be adjacent to Salmon and Woodin Creeks for which wetland areas will be created. These sites will create an area having similar structural and species diversity as impacted areas. For these mitigation sites the surface area for ground water recharge will be enhanced. There will be increased water quality improvement with a magnified aquifer recharge capability. The wildlife habitat and subsequent food chain will be vastly increased and flood and stream flow storage will be greatly enlarged.

Objective #1: The measure or standard of success of the plantings will be the survival and growth of the plant materials. Every effort will be made to ensure a favorable environment for initial plant growth, including mulching, fertilizing, soil amendments, and inspection of all plant material for vitality.

By the end of the fifth year of monitoring, success will be obtained if there is 80% areal coverage of native herbaceous species in the emergent zone in those areas indicated on the plan sheets, 80% areal coverage of native shrubs in the scrub-shrub zone, and 80% viability of all trees planted in the forested zone[8].

> Note: We are unable to adequately address survival 5 years after initial planting. We have addressed this standard with aerial cover of planted woody species.

Objective #2: Wildlife habitat will be upgraded by proposed native species plantings, when compared to existing agricultural use. Wildlife cover and forage availability will increase significantly, even with minimal revegetation survival rates. The ponding area will provide water/support for aquatic-dependent and other species.

After three years:

> Wildlife cover and forage species will increase resulting in a corresponding increase in wildlife use.

After five years:

> Wildlife cover and forage species should be established equal to percentages listed for vegetative structural and species diversity. **A visual increase in species should be observed.**

[8] By the end of the fifth year of monitoring, success will be obtained if there is 80% areal coverage of native herbaceous species in the emergent zone in those areas indicated on the plan sheets, 80% areal coverage of native shrubs in the scrub-shrub zone, and 80% viability of all trees planted in the forested zone.

Contingency Plans:

2.If viable vegetation plantings are less than 70% of the original and replacement plantings after the fourth year, resource agencies will be consulted for advice on further measures to remedy the problems at the site. The monitoring program will be extended and such reasonable measures will be performed as necessary to establish appropriate wetland vegetation. WSDOT will perform all reasonable measures considered necessary to establish and maintain a functioning wetland system.

3. Invasive exotic species will not be allowed to dominate the site. Exotic species establishment will be closely monitored. Mechanical and chemical control techniques will be used, when necessary, to maintain a predominance of native vegetation.

SR 509 Battle Ground East Plant List 2000

Species Name	Common Name	Status	Origin
Agrostis alba	redtop	FAC	Eur
Agrostis capillaris	colonial bentgrass	FAC	Eurasia
Alnus rubra	red alder	FAC	Native
Amelanchier alnifolia	Saskatoon service-berry	FACU	Native
Anthoxanthum odoratum	sweet vernal grass	FACU	Eur
Carex obnupta	slough sedge	OBL	Native
Carex ovalis	eggbract sedge	FAC	Native
Cirsium arvense	Canada thistle	FACU+	Eur
Cirsium vulgare	bull thistle	FACU	Eur
Cornus sericea	red-osier dogwood	FACW	Native
Crepis sp.	hawksbeard	---	---
Cytisus scoparius	Scotch broom	UPL	Intro
Daucus carota	Queen Anne's lace	NL	Eur
Deschampsia caespitosa	tufted hairgrass	FACW	Native
Eleocharis ovata	ovate spikerush	OBL	Native
Eleocharis palustris	common spikerush	OBL	Native
Epilobium ciliatum	hairy willow-herb	FACW-	Native
Festuca arundinacea	tall fescue	FAC-	Eur
Festuca rubra	red fescue	FAC+	Native
Fraxinus latifolia	Oregon ash	FACW	Native
Galium aparine	cleavers	FACU	Native
Gnaphalium uliginosum	marsh cudweed	NL	Eur
Holcus lanatus	common velvet grass	FAC	Eur
Hypericum perforatum	common St. John's-wort	NL	Eur
Hypochaeris radicata	spotted cat's-ear	FACU	Eur
Hypochaeris sp.	dandelion sp.	---	
Juncus acuminatus	tapertip rush	OBL	Native
Juncus effusus	soft rush	FACW	Native
Juncus ensifolius	dagger-leaf rush	FACW	Native
Juncus tenuis	slender rush	FACW-	Native
Lactuca serriola	prickly lettuce	FACU	Eur
Leontodon sp.	hawkbits	---	---
Leontodon taraxacoides	hairy hawkbit	UPL	Native
Leucanthemum vulgare	oxeye-daisy	NL	Native
Lotus corniculatus	birdsfoot trefoil	FAC	Eur
Lythrum portula	spatula-leaf loosestrife	NI	Eur
Mentha pulegium	penny-royal	OBL	Eur
Phalaris arundinacea	reed canarygrass	FACW	Nat & Intro
Physocarpus capitatus	Pacific ninebark	FACW-	Native
Plantago lanceolata	English plantain	FAC	Eur
Prunus emarginata	bitter cherry	FACU	Native

SR 509 Battle Ground East Plant List 2000, continued

Species Name	Common Name	Status	Origin
Rhamnus purshiana	cascara	FAC-	Native
Rosa nutkana	Nootka rose	FAC	Native
Rubus armeniacus	Himalayan blackberry	FACU	Eur
Rubus parviflorus	western thimbleberry	FAC-	Native
Rubus spectabilis	salmonberry	FAC+	Native
Rubus ursinus	California dewberry	FACU	Native
Salix lucida	Pacific willow	FACW+	Native
Sambucus racemosa	red elderberry	FACU	Native
Scirpus microcarpus	small-fruit bulrush	OBL	Native
Sparganium angustifolium	narrowleaf burreed	OBL	Native
Spiraea douglasii	Douglas' spiraea	FACW	Native
Symphoricarpos albus	common snowberry	FACU	Native
Trifolium repens	white clover	FAC	Eur
Vicia hirsuta	hairy vetch	NL	Eur
Vulpia octoflora	sixweeks fescue	NL	Native

Battle Ground Center Plant List 2000

Species Name	Common Name	Status	Origin
Agrostis alba	redtop	FAC	Eur
Agrostis capillaris	colonial bentgrass	FAC	Eurasia
Alnus rubra	red alder	FAC	Native
Amelanchier alnifolia	Saskatoon service-berry	FACU	Native
Anthoxanthum odoratum	sweet vernal grass	FACU	Eur
Carex obnupta	slough sedge	OBL	Native
Carex sp.	sedge	---	
Carex stipata	sawbeak sedge	OBL	Native
Cirsium arvense	Canada thistle	FACU+	Eur
Cirsium vulgare	bull thistle	FACU	Eur
Convolvulus arvensis	field morning glory	NL	Eur
Cornus sericea	red-osier dogwood	FACW	Native
Daucus carota	Queen Anne's lace	NL	Eur
Dactylis glomerata	orchard grass	FACU	Eur
Deschampsia caespitosa	tufted hairgrass	FACW	Native
Dipsacus sylvestris	teasel	FAC	Eur
Eleocharis ovata	ovate spikerush	OBL	Native
Eleocharis palustris	common spikerush	OBL	Native
Eleocharis parvula	small spikerush	OBL	Eur
Elytrigia repens	quackgrass	FAC-	Eurasia
Epilobium ciliatum	hairy willow-herb	FACW-	Native
Epilobium brachycarpum	autumn willow-herb	UPL	Native
Festuca rubra	red fescue	FAC+	Native
Fraxinus latifolia	Oregon ash	FACW	Native
Galium trifidum	small bedstraw	FACW+	Native
Gnaphalium uliginosum	marsh cudweed	NL	Eur
Holcus lanatus	common velvet grass	FAC	Eur
Holcus mollis	creeping velvet grass	FACU	Eur
Hypochaeris radicata	spotted cat's-ear	FACU	Eur
Juncus bufonius	toad rush	FACW	Native
Juncus effusus	soft rush	FACW	Native
Leersia oryzoides	rice cutgrass	OBL	Native
Leontodon taraxacoides	hairy hawkbit	UPL	Native
Lotus corniculatus	birdsfoot trefoil	FAC	Eur
Lolium multiflorum	Italian ryegrass	NL	Eur
Ludwigia palustris	marsh seedbox	OBL	Native
Malus fusca	Pacific crabapple	FACW	Native
Mentha pulegium	penny-royal	OBL	Eur
Parentucellia viscosa	yellow parentucellia	FAC-	Intro
Phalaris arundinacea	reed canarygrass	FACW	Nat & Intro
Physocarpus capitatus	Pacific ninebark	FACW-	Native

Battle Ground Center Plant List 2000 continued

Species Name	**Common Name**	**Status**	**Origin**
Plantago lanceolata	English plantain	FAC	Eur
Poaceae	grass family	---	
Polygonum sp.	knotweed/smartweed	---	
Populus balsamifera	black cottonwood	FAC	Native
Rhamnus purshiana	cascara	FAC-	Native
Rubus armeniacus	Himalayan blackberry	FACU	Eur
Rubus spectabilis	salmonberry	FAC+	Native
Rumex crispus	curly dock	FAC+	Intro
Rubus ursinus	California dewberry	FACU	Native
Salix lucida	Pacific willow	FACW+	Native
Salix sitchensis	Sitka willow	FACW	Native
Scirpus microcarpus	small-fruit bulrush	OBL	Native
Spiraea douglasii	Douglas' spiraea	FACW	Native
Symphoricarpos albus	common snowberry	FACU	Native
Thuja plicata	western red cedar	FAC	Native
Trifolium repens	white clover	FAC	Eur
Typha latifolia	broad-leaf cattail	OBL	Native
Veronica serpyllifolia	thyme-leaf speedwell	FAC	Nat-Int
Vicia sp.	vetches	---	

Battle Ground West Plant List 2000

Scientific Name	Common Name	Status	Origin
Agrostis alba	redtop	FAC	Eur
Agrostis capillaris	colonial bentgrass	FAC	Eurasia
Amelanchier alnifolia	Saskatoon service-berry	FACU	Native
Carex obnupta	slough sedge	OBL	Native
Carex unilateralis	one-side sedge	FACW	Native
Cirsium arvense	Canada thistle	FACU+	Eur
Cornus sericea	red-osier dogwood	FACW	Native
Eleocharis ovata	ovate spikerush	OBL	Native
Eleocharis palustris	common spikerush	OBL	Native
Fraxinus latifolia	Oregon ash	FACW	Native
Gnaphalium uliginosum	marsh cudweed	NL	Eur
Holcus lanatus	common velvet grass	FAC	Eur
Juncus tenuis	slender rush	FACW-	Native
Lonicera involucrata	black twinberry	FAC+	Native
Lotus corniculatus	birdsfoot trefoil	FAC	Eur
Ludwigia palustris	marsh seedbox	OBL	Native
Mentha pulegium	penny-royal	OBL	Eur
Myosotis laxa	small-flowered forget-me-not	OBL	Native
Oenanthe sarmentosa	water-parsley	OBL	Native
Parentucellia viscosa	yellow parentucellia	FAC-	Intro
Phalaris arundinacea	reed canarygrass	FACW	Nat & Intro
Physocarpus capitatus	Pacific ninebark	FACW-	Native
Polygonum persicaria	lady's thumb	FACW	Intro
Rubus armeniacus	Himalayan blackberry	FACU	Eur
Rubus laciniatus	evergreen blackberry	FACU+	Eur
Rubus spectabilis	salmonberry	FAC+	Native
Salix lucida	Pacific willow	FACW+	Native
Salix sitchensis	Sitka willow	FACW	Native
Salix sp.	willows	---	---
Scirpus microcarpus	small-fruit bulrush	OBL	Native
Spiraea douglasii	Douglas' spiraea	FACW	Native
Typha latifolia	broad-leaf cattail	OBL	Native

Battle Ground Sites Bird List 2000

Common Name	Scientific Name	Family Name	*Wetland Dependent
American Crow	*Corvus brachyrhynchos*	Corvidae	
American Goldfinch	*Carduelis tristis*	Fringillidae	
American Robin	*Turdus migratorius*	Turdidae	
Bank Swallow	*Riparia riparia*	Hirundinidae	X
Barn Swallow	*Hirundo rustica*	Hirundinidae	
Belted Kingfisher	*Ceryle alcyon*	Alcedinidae	X
Black-capped Chickadee	*Parus atricapillus*	Paridae	
Black-headed Grosbeak	*Pheucticus melanocephalus*	Emberizidae	
Brewer's Blackbird	*Euphagus cyanocephalus*	Icteridae	
Brown-headed Cowbird	*Molothrus ater*	Icteridae	
Cedar Waxwing	*Bombycilla cedrorum*	Bombycillidae	
Common Yellowthroat	*Geothlypis trichas*	Emberizidae	X
European Starling	*Sturnus vulgaris*	Sturnidae	
Great Blue Heron	*Ardea herodias*	Ardeidae	X
Killdeer	*Charadrius vociferus*	Charadriidae	
Lazuli Bunting	*Passerina amoena*	Emberizidae	
Mallard	*Anas platyrhynchos*	Anatidae	X
Marsh Wren	*Cistothorus palustris*	Troglodytidae	X
Mourning Dove	*Zenaida macroura*	Columbidae	
Northern Flicker	*Colaptes auratus*	Picidae	
Northern Oriole	*Icterus galbula*	Icteridae	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Hirundinidae	
Orange-crowned Warbler	*Vermivora celata*	Emberizidae	
Pacific-slope Flycatcher	*Empidonax difficilis*	Tyrannidae	
Pileated Woodpecker	*Dryocopus pileatus*	Picidae	
Red-tailed Hawk	*Buteo jamaicencis*	Accipitridae	
Red-winged Blackbird	*Agelaius phoeniceus*	Icteridae	X
Rock Dove	*Columba livia*	Columbidae	
Rufous Hummingbird	*Selasphorus rufus*	Trochilidae	
Savannah Sparrow	*Passerculus sandwichensis*	Emberizidae	
Scrub Jay	*Aphelocoma coerulescens*	Corvidae	
Song Sparrow	*Melospiza melodia*	Emberizidae	
Spotted Sandpiper	*Actitis macularia*	Scolopacidae	X
Spotted Towhee	*Pipilo maculatus*	Emberizidae	
Steller's Jay	*Cyanocitta stelleri*	Corvidae	
Swainson's Thrush	*Catharus ustulatus*	Turdidae	
Tree Swallow	*Tachycineta bicolor*	Hirundinidae	
Turkey Vulture	*Cathartes aura*	Cathartidae	
Violet-green Swallow	*Tachycineta thalassina*	Hirundinidae	
Western Wood-Pewee	*Contopus sordidulus*	Tyrannidae	
White-crowned Sparrow	*Zonotrichia leucophrys*	Emberizidae	
Willow Flycatcher	*Empidonax traillii*	Tyrannidae	
Wilson's Warbler	*Wilsonia pusilla*	Emberizidae	
Wood Duck	*Aix sponsa*	Anatidae	X

** Wetland dependent species are those that are considered restricted in temporal or spatial distribution to wetlands based on an intrinsic feature or features of the environment (Finch 1989).*

Glossary of Terms

Abundance (total) – the total number of individuals, cover, frequency of occurrence, volume, or biomass of a species, or group of species, within a given area.

Accuracy – the closeness of a measured or computed value to its true value.

Adaptive management – the process of linking ecological management within a learning framework.

Aerial cover - is the amount of ground covered by vegetation of a particular species or suite of species when viewed from above. Aerial cover is generally expressed as a percentage. This is typically obtained from herbaceous plot, point intercept, or line intercept data.

Areal estimates - are made using the mapped boundary of a feature as viewed from above. Areal estimates are a measure of area recorded as a number from 0 to 100, and not as a fraction or percent (Hruby et al. 1999). Compare this to the definition of percent cover.

Aquatic vegetation - includes submerged rooted (includes *Elodea, Characeae, Myriophyllum*) or floating non-rooted aquatic plants (includes *Lemna, Azolla, Wolfia*). For compliance purposes, these plants are not included in cover estimates.[9]

Bare ground - an area that can support, but does not presently support vascular vegetation (for compliance purposes, bare ground may include areas covered by cryptogams).

Benthic community - life in or on the sediments of a body of water.

Biological monitoring – the acquisition of information to assess the status and trend in status of the structure and functioning of biological populations and communities, and their habitat, and larger-scale ecological systems over time for the purpose of assessing and directing management activities (Elzinga et al. 1998).

Biological population – all of the individuals of one or more species within a prescribed area at a particular time.

Confidence interval (CI) – is an estimate of precision around a sample mean. A confidence interval includes confidence level and confidence interval half-width.

[9] For compliance purposes, vascular floating-leaved plants are included in cover estimates (e.g., *Nuphar, Potamogeton*).

Glossary (continued)

Canopy cover - the coverage of foliage canopy (herbaceous or woody species) per unit ground area.

Community - a group of populations of species living together in a given place and time.

Cryptogam - any of the *Cryptogamia*, an old primary division of plants comprising those without true flowers and seeds including ferns, mosses, and thallophytes (algae, fungi, and lichen).

Density – the number of individuals, stems, or other counting unit per unit area.

Ecotone - the boundary or transitional zone between adjacent communities.

Emergent plants - erect, rooted, herbaceous angiosperms that may be temporarily to permanently flooded at their base but do not tolerate prolonged inundation of the entire plant.

Floating plant - a non-anchored plant that floats freely in the water or on the water surface.

Floating-leaved plant - a rooted, herbaceous hydrophyte with some leaves floating on the water surface.

Herbaceous - with characteristics of an herb; an annual, biennial, or perennial plant that is leaflike in color or texture, or not woody.

Herbaceous cover - is the estimated aerial cover of herbaceous vegetation on a mitigation site; generally expressed as a percentage. Specifically, it is the proportion of ground covered by the herbaceous layer relative to the proportion of bare ground.

Hydric soils - soils formed under the conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register 1994).

Line transect – a transect for which the sampling unit is, theoretically, a line with no width.

Macroplot – usually refers to a relatively large sampling area in which subsampling will be conducted, often using quadrats and/or transects.

Management objective – a clear description of a measurable standard, desired state, threshold value, amount of change, or trend that you are trying to achieve for a particular population or habitat characteristic (Elzinga et al. 1998).

Glossary (continued)

Mud flat - a level landform composed of unconsolidated sediments. A mud flat may be irregularly shaped or elongate and continuous with the shore, whereas bars are generally elongate, parallel to the shore, and separated from the shore by water (Cowardin et al. 1979).

Open water - an area intended to be non-vegetated and permanently inundated as described in the site mitigation or planting plan.

Plot - a general term applied to any size of a circumscribed sampling unit for vegetation.

Point frame – is a linear, square, or rectangular quadrat that consists of a number of points used to collect vegetation data.

Point quadrat (points) – is a plot with a very small area, a single point, used to collect vegetation data. The point quadrat is theoretically dimensionless.

Population (biological) – all individuals of one or more species within a specific area at a particular time.

Population (statistical) - the complete set of individual objects (sampling units) about which you want to make inferences.

Precision – the closeness of repeated measurements of the same quantity.

Quadrat - an area delimited for sampling flora or fauna; the sampling frame itself.

Random sampling – sampling units drawn randomly from the population of interest.

Relative abundance (birds) – the number of individuals per unit of sampling effort.

Restricted random sampling – a sampling method that divides the population of interest into equal-sized segments. In each segment, a single sampling unit is randomly positioned. Sampling units are then analyzed as if they were part of a simple random sample.

Sample – a subset of the total possible number of sampling units in a statistical population.

Sample standard deviation – a value indicating how similar each individual observation is to the sample mean.

Sample statistics – are descriptive measures that are estimates of population parameters.

Glossary (continued)

Sampling – the act or process of selecting a part of something with the intent of showing the quality, style, or nature of the whole.

Sampling objective – a clearly articulated goal for the measurement of an ecological condition or change value (Elzinga et al. 1998).

Sampling units – the individual objects that collectively make up a statistical population, e.g., an individual plant, quadrats (plots), points, or transects (lines).

Standard deviation (SD) – a measure of how similar each individual observation is to the overall mean value.

Shrub - a woody plant which at maturity is usually less than 6m (20 feet) tall and generally exhibits several erect, spreading, or prostrate stems and has a bushy appearance (Cowardin et al. 1979). The species categories in this report follow Cooke (1997).

Species richness (birds) - the total number of bird species observed on a site.

Species richness (plant) - is the total number of species recorded on a site (herbaceous and woody).

Structures - any structure that is not expected to support vegetation in the short-term (during the monitoring period). These structures may include habitat structures, rocks, and other artifacts.

Systematic Random Sampling – the regular placement of quadrats, points, or lines along a sampling transect following a random start.

Transect - a line or narrow belt to survey the distributions or abundance of organisms across an area.

Tree - a woody plant that at maturity is usually 6m (20 feet) or more in height and generally has a single trunk, unbranched for 1m or more above ground, and more or less definite crown (Cowardin et al. 1979). The species categories in this report follow Cooke, 1997.

Vegetation structure - the physical or structural description of the plant life, e.g. the relative biomass (cover) in canopy layers; generally independent of particular species composition.

Wetland-dependent species (birds) - restricted in temporal or spatial distribution to wetlands based on an intrinsic feature or features of the environment (Finch, 1989).

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